BEFORE THE
PUBLIC SERVICE COMMISSION OF
SOUTH CAROLINA

DOCKET NO. 2020-1-E

In the Matter of Annual Review of Base Rates for Fuel Costs for Duke Energy Progress, LLC	))))	**DIRECT TESTIMONY OF** **KELVIN HENDERSON FOR** **DUKE ENERGY PROGRESS, LLC**

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Kelvin Henderson and my business address is 526 South Church Street, Charlotte, North Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am Senior Vice President of Nuclear Operations for Duke Energy Corporation ("Duke Energy") with direct executive accountability for Duke Energy's North Carolina nuclear stations, including Duke Energy Progress, LLC's ("DEP" or the "Company") Brunswick Nuclear Station ("Brunswick") in Brunswick County, North Carolina, the Harris Nuclear Station ("Harris") in Wake County, North Carolina, and Duke Energy Carolinas, LLC's ("DEC") McGuire Nuclear Station, located in Mecklenburg County, North Carolina.

Q. WHAT ARE YOUR RESPONSIBILITIES AS SENIOR VICE PRESIDENT OF NUCLEAR OPERATIONS?

A. As Senior Vice President of Nuclear Operations, I am responsible for providing oversight for the safe and reliable operation of Duke Energy's nuclear stations in North Carolina. I am also involved in the operations of Duke Energy's other nuclear stations, including DEP's Robinson Nuclear Station ("Robinson") located in Darlington County, South Carolina.

Q. PLEASE SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.

A. I have a Bachelor's degree in Mechanical Engineering from Bradley University and over 28 years of nuclear energy experience with increasing responsibilities. My nuclear career began at Commonwealth Edison's Zion Nuclear Station in Illinois where I received a senior reactor operator license from the Nuclear Regulatory Commission ("NRC") and served as a control room unit supervisor. In 1998, I joined Progress Energy in the operations department at the

Harris Nuclear Station. After serving in various leadership roles in Operations, Work Management, and Maintenance, I was named plant manager at Harris. In 2011, I was named general manager of nuclear fleet operations for Progress Energy. Following the Duke Progress merger in 2012, I became site vice president of DEC's Catawba Nuclear Station in York County, South Carolina. In 2016, I was named senior vice president of corporate nuclear, and I assumed my current role as Senior Vice President of Nuclear Operations in December 2017.

Q. HAVE YOU TESTIFIED BEFORE THIS COMMISSION IN ANY PRIOR PROCEEDINGS?

A. Yes, I testified in DEP's 2018 fuel costs proceeding in Docket No. 2018-1-E, in DEP's 2019 fuel costs proceeding in Docket No. 2019-1-E, and in DEP's base rate proceeding in Docket No. 2018-318-E.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. The purpose of my testimony is to describe and discuss the performance of Brunswick, Harris, and Robinson for the period of March 1, 2019 through February 29, 2020 (the "review period").

Q. YOUR TESTIMONY INCLUDES THREE EXHIBITS. WERE THESE EXHIBITS PREPARED BY YOU OR AT YOUR DIRECTION AND UNDER YOUR SUPERVISION?

A. Yes. These exhibits were prepared at my direction and under my supervision.

Q. PLEASE PROVIDE A DESCRIPTION OF THE EXHIBITS.

A. The exhibits and descriptions are as follows:

Henderson Exhibit 1 - Calculation of the nuclear capacity factor for the review period pursuant to S.C. Code § 58-27-865

Henderson Exhibit 2 - Nuclear outage data for the review period

Henderson Exhibit 3 - Nuclear outage data through the billing period [1]

Q. PLEASE DESCRIBE DEP'S NUCLEAR GENERATION PORTFOLIO.

A. The Company's nuclear generation portfolio consists of approximately 3,593[2] megawatts ("MWs") of generating capacity, made up as follows:

Brunswick - 1,870 MWs

Harris - 964 MWs

Robinson - 759 MWs

Q. PLEASE PROVIDE A GENERAL DESCRIPTION OF DEP'S NUCLEAR GENERATION ASSETS.

A. The Company's nuclear fleet consists of three generating stations and a total of four units. Brunswick is a boiling water reactor facility with two units and was the first nuclear plant built in North Carolina. Unit 2 began commercial operation in 1975, followed by Unit 1 in 1977. The operating licenses for Brunswick were renewed in 2006 by the NRC, extending operations up to 2036 and 2034 for Units 1 and 2, respectively. Harris is a single unit pressurized water reactor that began commercial operation in 1987. The NRC issued a renewed license for Harris in 2008, extending operation up to 2046. Robinson is also a single unit pressurized water reactor that began commercial operation in 1971. The license renewal for Robinson Unit 2 was issued by the NRC in 2004, extending operation up to 2030.

[1] This data is provided in confidential and publicly redacted versions for security purposes.
[2] As of January 1, 2020.

Q. WERE THERE ANY CAPACITY CHANGES WITHIN DEP'S NUCLEAR PORTFOLIO DURING THE REVIEW PERIOD?

A. Yes. During the fall 2018 Robinson refueling outage, both low pressure turbines were replaced with a new design. After analysis, testing, and observation in both the winter and summer periods of 2019, the Robinson maximum dependable capacity was increased from 741 MWs to 759 MWs effective January 1, 2020; a gain of 18 MWs.

Q. WHAT ARE DEP'S OBJECTIVES IN THE OPERATION OF ITS NUCLEAR GENERATION ASSETS?

A. The primary objective of DEP's nuclear generation department is to safely provide reliable and cost-effective electricity to DEP's Carolinas customers. The Company achieves this objective by focusing on a number of key areas. Operations personnel and other station employees are well-trained and execute their responsibilities to the highest standards in accordance with detailed procedures. The Company maintains station equipment and systems reliably, and ensures timely implementation of work plans and projects that enhance the performance of systems, equipment, and personnel. Station refueling and maintenance outages are conducted through the execution of well-planned, well-executed, and high-quality work activities, which effectively ready the plant for operation until the next planned outage.

Q. PLEASE DISCUSS THE PERFORMANCE OF DEP'S NUCLEAR FLEET DURING THE REVIEW PERIOD.

A. The Company operated its nuclear stations in a reasonable and prudent manner during the review period, providing approximately 47.7% of the total power generated by DEP. The four nuclear units operated at an actual system average capacity factor of 91.74% during the review period. Prior to the expected landfall of Hurricane Dorian in September 2019, both

Brunswick units were brought offline, consistent with site procedures. Brunswick Unit 1 was offline for 3.8 days and Unit 2 was offline for 2.3 days.

As shown on Henderson Exhibit 1, DEP achieved a net nuclear capacity factor, excluding reasonable outage time, of 101.97% for the review period. This capacity factor is above the 92.5% set forth in S.C. Code § 58-27-865(F), which states in pertinent part:

> There shall be a rebuttable presumption that an electrical utility made every reasonable effort to minimize cost associated with the operation of its nuclear generation facility or system, as applicable, if the utility achieved a net capacity factor of ninety-two and one-half percent or higher during the period under review. The calculation of the net capacity factor shall exclude reasonable outage time associated with reasonable refueling, reasonable maintenance, reasonable repair, and reasonable equipment replacement outages; the reasonable reduced power generation experienced by nuclear units as they approach a refueling outage; the reasonable reduced power generation experienced by nuclear units associated with bringing a unit back to full power after an outage....

The performance results discussed above support DEP's continued commitment for achieving high performance without compromising safety and reliability.

Q. WHAT IMPACTS A UNIT'S AVAILABILITY AND WHAT IS DEP'S PHILOSOPHY FOR SCHEDULING REFUELING AND MAINTENANCE OUTAGES?

A. In general, refueling requirements, maintenance requirements, and NRC operating requirements impact the availability of DEP's nuclear system. Prior to a planned outage, DEP develops a detailed schedule for the outage and for major tasks to be performed including sub-schedules for particular activities.

The Company's scheduling philosophy is to plan for a best possible outcome for each outage activity within the outage plan. For example, if the "best ever" time a particular outage task was performed is 10 days, then 10 days or less becomes the goal for that task in each

subsequent outage. Those individual goals are incorporated into an overall outage schedule. The Company aggressively works to meet, and measures itself against, that schedule. Further, to minimize potential impacts to outage schedules, "discovery activities" (walk-downs, inspections, etc.) are scheduled at the earliest opportunities so that any maintenance or repairs identified through those activities can be promptly incorporated into the outage plan. Those discovery activities also have pre-planned contingency actions to ensure that, when incorporated into the schedule, the activities required for appropriate repair can be performed as efficiently as possible.

As noted, the Company uses the schedule for measuring outage planning and execution and driving continuous improvement efforts. However, in order to provide reasonable, rather than best ever, total outage time for planning purposes, particularly with the dispatch and system operating center functions, DEP also develops an allocation of outage time which incorporates reasonable schedule losses. The development of each outage allocation is dependent on maintenance and repair activities included in the outage, as well as major projects to be implemented during the outage. Both schedule and allocation are set aggressively to drive continuous improvement in outage planning and execution.

Q. HOW DOES DEP HANDLE OUTAGE EXTENSIONS AND FORCED OUTAGES?

A. When an outage extension becomes necessary, DEP believes that work completed in the extension results in longer continuous run times and fewer forced outages, thereby reducing fuel costs in the long run. Therefore, if an unanticipated issue that has the potential to become an on-line reliability issue is discovered while a unit is off-line for a scheduled outage and repair cannot be completed within the planned work window, the outage is usually extended to perform necessary maintenance or repairs prior to returning the unit to service. In the event

that a unit is forced off-line, every effort is made to safely perform the repair and return the unit to service as quickly as possible.

Q. DOES DEP PERFORM POST-OUTAGE CRITIQUES AND CAUSE ANALYSES FOR INTERNAL IMPROVEMENT EFFORTS?

A. Yes. The nuclear industry recognizes that constant focus on operational excellence results in improved nuclear safety and reliability. As such, DEP applies self-critical analysis to each outage to identify every potential cause of an outage delay or event resulting in a forced or extended outage. These critiques and cause analyses do not document the broader context of the outage or event, and thus rarely reflect strengths and successes.

Q. **WHAT IS THE RELATIONSHIP BETWEEN THE STANDARDS THAT THE COMPANY APPLIES IN ITS POST OUTAGE CRITIQUES AND THE "EVERY REASONABLE EFFORT" STANDARD OF SECTION 58-27-865?**

In the Company's outage evaluations, we are striving to identify any opportunity for improvement. We are not assessing the "reasonableness" of any conduct or actions that might have contributed to the outage. Reasonableness focuses on what was done in light of what was known prior to the event; in our outage evaluations we are focused on learning and applying new lessons from our experiences in order to improve our operations. The fact that an outage investigation may indicate ways we can improve our future operations does not indicate that we have determined that our previous practices did not meet the reasonableness standard.

Q. WHAT REFUELING OUTAGES WERE REQUIRED AT DEP'S NUCLEAR FACILITIES DURING THE REVIEW PERIOD?

A. There were two refueling outages completed during the review period, Harris and Brunswick Unit 2.

Harris shut down for scheduled refueling on October 12, 2019. Maintenance activities, safety enhancements and inspections were completed as the unit was refueled. Significant projects completed included the replacement of the unit's reactor vessel head, resolving the susceptibly of stress corrosion cracking and reducing O&M costs and time required for inspections and repairs. Main generator work completed included stator re-wedge and rotor insulator repairs. Large pump and motor refurbishments and replacements included the 'B' essential chiller compressor and motor, 'B' emergency service water pump and motor, 'B' condensate pump and motor, and the 'B' heater drain pump motor. Steam generator and main generator and exciter inspections were completed. After refueling, modifications, maintenance and inspections were completed, the unit returned to service on November 18, 2019. The outage duration was 37.6 days versus a scheduled allocation of 39 days.

Brunswick Unit 2 was disconnected from the grid for refueling on March 2, 2019. In addition to refueling, safety and reliability enhancements were completed during the outage. Projects to replace the aging original feedwater heaters continued with the replacement of the 3A and 3B feedwater heaters during the outage. These replacements improve system reliability and reduce maintenance costs. Replacement of all 20 original feedwater heaters is scheduled to be completed by the spring of 2028. Fouled feedwater venturis were also replaced, improving accuracy of feedwater flow measurement and increasing efficiency of the system and unit. The main turbine electro-hydraulic control system was replaced with a

modern digital turbine control system. This replacement eliminates several single-point vulnerabilities, addresses aging and obsolescence issues, and reduces the likelihood of unplanned turbine trips. The 2A and 2B reactor recirculation pump seals were replaced with an improved design. The new design, first installed on the Unit 1 "B" pump in 2018, have performed as designed and are providing improved reliability.

The refueling outage for Unit 2 extended 10 days beyond allocation due to issues with a turbine bearing and required extent of condition inspections after Unit 1 experienced a drywell leak associated with a failed instrument coupling. As the unit was placing the turbine in service and preparing to exit the outage, an unanticipated failure of a turbine bearing occurred. As the Company was addressing the bearing issue, the Unit 1 coupling failure occurred. The Company was required to inspect and replace similar couplings on Unit 2 before returning the unit to service. After refueling, required maintenance, and inspections were completed, the unit returned to service on April 13, 2019. The turbine was removed from service for just over an hour to complete turbine overspeed testing. The outage duration was 42[3] days compared to a scheduled allocation of 32 days.

Q. DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes, it does.

[3] The 42-day outage duration aligns with Company internal and INPO reporting standards and policies. NERC reporting standards concluded the refueling outage on April 2, 2019 (32-day duration) and categorized the period from April 3 to April 13, 2019 as a separate forced outage event.

DUKE ENERGY PROGRESS, LLC
SOUTH CAROLINA ANNUAL REVIEW OF BASE RATES FOR FUEL COSTS
NUCLEAR CAPACITY FACTOR PURSUANT TO S.C. CODE ANN. § 58-27-865(F)
REVIEW PERIOD OF MARCH 2019 THROUGH FEBRUARY 2020

1	Nuclear System Actual Net Generation During Review Period	28,833,643	MWH
2	Total Number of Hours during Review Period	8,784	
3	Nuclear System MDC during Review Period	3,578.00	MW
4	Reasonable Nuclear System Reductions	3,152,846	MWH
5	Nuclear System Capacity Factor = L1/((L2a*L3a)-L4)	101.97	%

DUKE ENERGY PROGRESS, LLC
SOUTH CAROLINA ANNUAL REVIEW OF BASE RATES FOR FUEL COSTS
NUCLEAR OUTAGE DATA FOR REVIEW PERIOD OF
MARCH 2019 THROUGH FEBRUARY 2020

Nuclear outages lasting one week or more during the Review Period

Station/Unit	Date of Outage	Explanation of Outage
Brunswick 2	3/2/2019 - 4/3/2019	Scheduled Refueling - EOC 24
Brunswick 2 [1]	4/3/2019 - 4/13/2019	Forced outage to address extent of condition\repairs on instrument couplings
Brunswick 1	3/28/2019 - 4/11/2019	Forced outage due to drywell leak\failed instrument coupling
Robinson	8/11/2019 - 9/3/2019	Forced outage due to generator exciter failure
Harris	10/12/2019 - 11/18/2019	Scheduled Refueling - EOC 22

[1] This table aligns with NERC reporting standards. As Brunswick 2 was nearing completion of the scheduled refueling outage, Brunswick Unit 1 was forced offline due to a drywell leak caused by a failed instrument coupling. This required Brunswick Unit 2 to complete an extent of condition investigation and inspect and repair, as necessary, similar couplings before Unit 2 could restart from the refueling outage. NERC reporting standards requires that this extension of the refueling outage is considered as a separate forced outage event. Internal Company reporting aligns with the industry's INPO standards, which considers the 4/3 to 4/13/2020 time period as an unplanned extension of the refueling outage.

DUKE ENERGY PROGRESS, LLC
SOUTH CAROLINA ANNUAL REVIEW OF BASE RATES FOR FUEL COSTS
NUCLEAR OUTAGE SCHEDULE THROUGH BILLING PERIOD
MARCH 2020 THROUGH JUNE 2021

Scheduled nuclear outages lasting one week or more through the Billing Period

Station/Unit	Date of Outage[1]	Explanation of Outage

REDACTED

[1] This exhibit represents DEP's current plan, which is subject to change based on fluctuations in operational and maintenance requirements.